in the German technical colleges, that so far as possible no lectures are to be delivered without the accompanying tutorials.

In all the departments devoted to different professional branches, the course is a four-year one. At the conclusion of the second year, the preliminary examination for the degree or diploma is held, the final examination being taken at the close of the fourth year. The first two years are principally devoted to the more general studies in mathematics and natural science subjects, although a beginning is made with the introductory lectures and tutorials in the main subjects at the outset of the first term. But whereas the general subjects at first take up much more of the student's time than the special subjects, this proportion gradually alters as the course proceeds till it finally becomes reversed.

Another feature of the arrangement of the studies is that the lectures are, so far as possible, delivered during the earlier terms, while the drawing-office work gradually assumes greater importance as the course proceeds. This is intended to give the student in his last year as broad a base as possible for designing and applying what he has learnt from the lectures.

The primary object of the course of instruction during the first two years is to give the student a general grounding on the broadest possible lines in mathematics and natural science subjects, and concurrently therewith to introduce him to the elements of his special subject, so that, after passing the preliminary examination, he may devote himself in a higher degree to the direct study of his profession during the last two years.

In the course of these two years, then, the tutorials gradually take the place of the lectures, and the professional study proper is gone into in detail. The student of naval architecture is engaged in designing and working out the plans of merchant and war vessels, and in studying the arrangement and working of shipyards, while the marine engineering student is at work on marine boilers, reciprocating, turbine, and internal-combustion engines. In addition, auxiliary engines and propellers are thoroughly gone into.

Students in each branch concern themselves with the other just so far that, in their respective parts of the work on one and the same vessel, they can completely understand one another, and give due consideration to each other's requirements.

The domain of airship construction and aërial navigation, which is closely related to naval architecture, has been included in the province of the latter, and it may be of interest to mention that quite a number of the first designers and engineers who have specialised in airship construction were formerly students in the department of naval architecture.

One of the important aims of science as applied to naval architecture is directed to the keeping of the rules of the classification societies in general accordance with the latest advances in knowledge. This refers chiefly to the arrangement, scantlings, and riveting together of the structural parts of the hulls of vessels, and to the application of the laws of mechanics, statics, and dynamics. A second aim is that the rules of these societies, which are gradually gaining in authority, shall be prevented from developing into crystallised and inelastic ordinances which interfere with the scientific development of ship design.

Both for instructional purposes and for scientific research work, suitable laboratories are nowadays of the very greatest value. In all branches of engineering, there are many questions the solution of which by pure analytical methods is impossible, and which therefore can only be dealt with by practical experiment. To what excellent use in this way have not the existing testing laboratories in almost all countries been put! At the Technical College in Charlottenburg the mechanical engineering section in particular has established numerous laboratories, and they have been of the utmost value both from the educational and from the industrial point of view.

The Technical College at Charlottenburg now possesses twenty laboratories, which serve the purposes of the research work of the professors as well as those of instruction. A short time ago a project for the installation of a second laboratory for the civil engineering section for the investigation of hydraulic questions was unfortunately rejected by the Prussian House of Representatives. It is a remarkable circumstance that in the entire establishment the section for shipbuilding and engineering should be the only one which has no laboratory! It must be admitted that this is very much to be deplored, and that the course of instruction as well as the solution of engineering problems is immensely impeded thereby. It may readily be understood, therefore, that the naval architectural section is doing its best towards the early attainment of an establishment of this kind so as to close up the gap in its structure.

My endeavours are directed to the establishment of a suitable naval architecture laboratory in which experiments may be made on the action of the screw propeller, and in which the gross and net amounts of work done by the latter, *i.e.* its efficiency, may at the same time be determined. Further experiments will then be made to determine the effect on each other of several screw propellers arranged abreast, or one behind the other, and also the effect exercised on them by the rudder. We shall then know whether it is possible to design high-speed propellers of high efficiency, and our knowledge over a wide range of under-water phenomena will be available for further advances in this branch of engineering. Students should take part in all inquiries of this kind, so that the results may benefit succeeding generations of engineers and enable them to play a leading part in the scientific progress of their time.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

A REUTER message from Simla on August 3 states that Lord Crewe has accepted the scheme for a Mohammedan University at Aligarh, provided adequate financial support is forthcoming.

WE have received from the Department of Technology of the City and Guilds of London Institute the programme for the session 1911–12, containing regulations for the registration, conduct, and inspection of classes and examination of candidates in technological subjects, and for the award of teachers' certificates in manual training and domestic subjects. We notice that the names of the two examinations held at the end of the session have been changed from "ordinary grade" and "honours grade" to "grade I." and "final examination," corresponding, in a sense, to the two new examinations in science subjects instituted by the Board of Education under the names of "lower" and "higher"; but in certain subjects there are first- and second-grade examinations before the final examination can be taken. The list of subjects in which examinations are to be held in 1912 numbers seventy-nine, as compared with seventy-eight during the present year. The new subject is entitled "Heating and Lighting," and covers very fully the science and technology of these important processes. All inquiries for information in connection with the recognition of classes in technological subjects, examinations, and inspection should be addressed to the Superintendent, Department of Technology, City and Guilds of London Institute, Exhibition Road, London, S.W.

THE eighth annual report of the Education Committee of the City Council of Manchester for the year 1909–10 gives much interesting information as to the progress which is being made in the various grades of education administered by the committee. In the Municipal School of Technology the number of individual day and evening students enrolled for the session ending July 31, 1910, was 5018, as compared with 4988 for the same period in 1907–8, an increase of 30. The number of individual students enrolled in the day departments was 733, as compared with 780 for the session 1908–9. The class entries for the session were 11,071, against 10,500 for the session 1908–9. These figures do not include the class entries in respect of students in the day departments of the school. During the session, 200 students in the day departments of the school were enrolled as students of the Victoria University of Manchester in the faculty of technology, 97 with a

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view to qualify either for the degrees of Master and Bachelor of Technical Science, and 103 for the certificate in technology. A large amount of original work was carried out by members of the staff and the more advanced students pursuing post-graduate courses in the various departments. Much of the work has been embodied in papers read before scientific societies, and published in the scientific and technical Press. The full record affords proof that the school compares favourably in the matter of research with other institutions of a similar character. Under the regulations adopted by the committee, a considerable number of tests and commercial investigations have been carried out during the year, chiefly in the departments of engineering and chemistry.

The new handbooks containing the arrangements for the session 1911–12 at University College, London, in the faculty of engineering, the school of architecture, and the faculty of medical sciences have now been published. The college is a university centre for preliminary and intermediate medical studies. Its faculty of medical sciences comprises the departments of physics, chemistry, botany, and zoology (the preliminary medical sciences), also the departments of anatomy, physiology, and pharmacology (the intermediate medical sciences), and the departments of hygiene and public health and of pathological chemistry (post-graduate study). Each of the departments is also equipped for more advanced work, and provides facilities for research. The faculty of engineering, including the departments of mechanical heating and ventilation, electrical, civil and municipal engineering, is intended to provide for students wishing to devote themselves to engineering a systematic training in the application of scientific principles to industrial purposes. The courses are also suited to the requirements of students who intend to enter for appointments in the Indian Public Works Department, engineering department of the General Post Office, department of the director of engineering and architectural works in the Admiralty, Patent Office, and other similar services. The departments have been recognised by the Board of Trade as providing suitable technical training for marine engineers. Facilities are provided for post-graduate and research work in all the subjects. All communications should be addressed to the Provost, University College, London.

SOCIETIES AND ACADEMIES.

Edinburgh.

Royal Society, June 19.—Prof. Bower, F.R.S., vice-president, in the chair.—M. Jules **Cardot**: Les Mousses de l'Expédition nationale antarctique écossaise. These were collected in various localities visited, and included a number of new species and genera.—Dr. J. **Aitken**, F.R.S.: Some nuclei of cloudy condensation. Some years previously the author, when enumerating the dust particles in the air at certain regions of the West Highlands remote from centres of population, had noticed from time to time a sudden, and at first inexplicable, increase in the number of dust particles. A recent study of the phenomenon had shown that the increase was due to the sunning of the material on the foreshore of neighbouring islands and coasts. The paper discussed the probable causes of this production of dust particles, and described a number of experiments on the direct effect of sunlight upon various substances.—Dr. A. A. **Lawson**: Nuclear osmosis as a factor in the mechanism of mitosis. A study of the spore mother-cells of Disporum, Gladiolus, Yucca and Hedera, and the vegetative cells in the root tip of Allium, has revealed a series of stages in the development of the mitolic spindle which has hitherto been overlooked. They are important and critical stages concerning the fate of the nuclear membrane, and are to be found in the early prophase, preceding the organisation of the equatorial plate. Contrary to the generally accepted view, it has been found that the nuclear membrane does not break down during spindle formation, but behaves as a permeable plasmatic membrane should behave under varying osmotic conditions. The interpretation of these stages throws an entirely new light on the problem of the "mechanism of mitosis," and necessitates a revision of the accepted views of nuclear phenomena. It goes to prove that osmotic conditions are active factors in the formation of the acromatic spindle.—Dr. A. G. **M'Kendrick** and Dr. Kesava **Pai**: The rate of multiplication of micro-organisms: a mathematical study. Assuming the law that the rate of increase of fast-growing organisms is proportional to the number of organisms present and to the concentration of the food-stuff, the authors express this in the mathematical form $dy/dt = by(a-y)$. At the beginning, y is small compared with a, so that the constant ab is equal to the rate of change of log y. From the graph which gives log y in terms of time, the value of ab may be readily obtained, and from the indications of the experiments the limit a towards which y tends may be inferred. The quantity also gives by a simple calculation the period of a generation. The numbers calculated from the integrated expression were found to be in good agreement with the numbers obtained by direct measurement.

July 3.—Dr. Horne, F.R.S., vice-president, in the chair.—Prof. A. H. **Gibson**: The resistance to flow of water through pipes or passages having divergent boundaries. The rate of loss of head in water flowing steadily along various types of expanding tubes was the object of the research—such types as circular pipes with uniformly diverging boundaries, rectangular pipes with two sides parallel and the other pair uniformly diverging, trumpet-shaped pipes with the curved boundary made so that the square of the speed fell off uniformly with distance, &c. In this last-named form there was a distinct reduction in the loss of head in a given length as compared with the loss in uniformly diverging tubes. The divergence which gave greatest efficiency was from 10° to 16° in the rectangular pipes, and from 7° to 10° in the circular pipes.—Dr. W. T. **Gordon**: The structure and affinities of *Metaclepsydropsis* (*Zygopteris*) *duplex* (Williamson). This Carboniferous fern was first recorded by Williamson in 1874, when he was investigating the structure of fossil plants from Pettycur, Fife, numerous petioles of the fern being discovered among his specimens. The same species had since been obtained near Régmy, in France; but in all these cases only fragments of petioles and pinnæ were discovered. Recently, however, stems and roots have been found at Pettycur. In a silicified mass of material several pieces of stems were obtained in close association with innumerable fragments of petioles and pinnæ. Certain emergences from the stem were noted, and an examination of the petioles soon established a series showing a continuous variation from the normal petiole trace to a trace which was identical with these emergences. In this way it was proved that the stems and petioles belonged to one and the same species. The stem stele is very simple in structure. The axis consists of a circular cylinder in which the outer zone is composed of long stout tracheides, while the inner zone is formed by a mixture of long narrow tracheides and conjunctive parenchyma. The stem emits petiole and root-traces at long intervals, and occasionally bifurcates dichotomously. In the theory of the medullation of the zygopterid stele, this stem is of some importance, since it exhibits a stage closely similar to that shown in the stem of *Ankyropteris corrugata* (Williamson). Like some other members of the Zygopterideæ, *A. corrugata* has a biseriate arrangement of the primary pinnæ, while in *M. duplex* and others a quadriseriate distribution of these appendages is shown. In both the quadriseriate and biseriate divisions it is now possible to arrange the stems in a series which demonstrates the gradual medullation of the stems, and is, at the same time, compatible with the geological age of the specimens:—

	Quadriseriate division	Biseriate division	
Lower Carboniferous	(1) *Diplolabis römeri*	(1) No known stem	
	(2) *Metaclepsydropsis duplex*		
Upper Carboniferous	(3) *Etapteris diupsilon* (*Lygopteris Grayi*)	(2) *Ankyropteris corrugata*	
Permian ...	... ...	(3) a. *Ankyropteris scandens* b. *Ankyropteris Decaisnei* c. *Ankyropteris Brongniarti*	These three probably the same species

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